1891MNRAS..51..402W

Disturbing Action of Saturn.

1888.	ΔL_1.	ΔL_2.	$\Delta\pi$.	$\Delta\Omega$	Δi.	$\Delta\phi$.	40 $\Delta\mu$.
	″	″	″	″	″	″	″
Feb. 16	−1·00	−0·08	+ 1·29	+0·08	−0·03	−0·48	−0·057
Mar. 27	−0·50	−0·01	+ 0·74	+0·01	−0·01	−0·18	−0·008
May 6	0·00	0·00	0·00	0·00	0·00	0·00	0·000
June 15	+0·45	−0·01	− 1·00	0·00	−0·01	+0·08	−0·030
July 25	+0·83	−0·07	− 2·32	0·00	−0·02	+0·09	−0·094
Sept. 3	+1·09	−0·21	− 3·93	−0·04	−0·05	+0·05	−0·185
Oct. 13	+1·23	−0·45	− 5·80	−0·12	−0·08	0·00	−0·295
Nov. 22	+1·24	−0·80	− 7·82	−0·26	−0·11	−0·04	−0·415
1889.							
Jan. 1	+1·12	−1·28	− 9·86	−0·45	−0·15	−0·07	−0·535
Feb. 10	+0·88	−1·87	−11·76	−0·70	−0·17	−0·08	−0·642
Mar. 22	+0·56	−2·55	−13·40	−0·99	−0·19	−0·09	−0·723
May 1	+0·19	−3·30	−14·70	−1·29	−0·20	−0·14	−0·768
June 10	−0·20	−4·07	−15·67	−1·57	−0·19	−0·24	−0·766
July 20	−0·55	−4·81	−16·42	−1·82	−0·17	−0·42	−0·716
Aug. 29	−0·82	−5·48	−17·11	−2·01	−0·15	−0·69	−0·623
Oct. 8	−0·97	−6·05	−17·86	−2·13	−0·12	−1·00	−0·505
Nov. 17	−0·98	−6·49	−18·63	−2·18	−0·09	−1·30	−0·382
Dec. 27	−0·87	−6·83	−19·26	−2·17	−0·07	−1·56	−0·281

The above values are for Greenwich mean noon.

Reduction of Measures of the Photographs of Jupiter taken at the Lick Observatory in 1890. By A. Stanley Williams.

Through the kindness of Professor E. S. Holden, I have recently been favoured with particulars of an important series of measurements of the belts of *Jupiter*, made by him on the remarkably fine series of photographs of the planet which he obtained last year by means of the great Lick refractor. These measures furnished on reduction the zenographical latitudes of the principal belts; and, as the results are interesting in more ways than one, I herewith beg to present them to the Society.

The photographs measured were enlarged directly in the telescope 8·3 times, the image of the planet on the plates taken at about the time of opposition being very nearly an inch in diameter. The distances were measured by Professor Holden in millimetres from the north pole to the middle points of the chief belts, and the minor axis of the disc was also measured on each plate. In order to show clearly the method of reduction em-

1891MNRAS..51..402W

ployed in the present case, the details are given fully below for one of the belts—namely, the dark belt No. 6:

Date.		G.M.T. of Photograph.		Minor Axis.	Dist. from N. Pole.	Dist. from Centre of Disc.	Corresponding Latitude.	Correction B.	True Zenographical Latitude.
1890.		h	m	mm.	mm.		°	°	°
July	8	21	3	21·5	16·0	−·488	−27·64	−·27	−27·91
	13	21	13	21·6	16·0	·482	27·27	·28	27·55
Aug.	31	18	25	21·2	15·5	·462	26·01	·38	26·39
Sept.	1	18	3½	21·1	15·5	·469	26·45	·38	26·83
	8	18	9	20·7	15·5	·498	28·28	·40	28·68
	14	17	14	20·3	15+	(·478)	27·01	·41	(27·42)
Oct.	19	15	17	18·4	13·9	·511	29·11	·42	29·53
	19	15	29	...	13·7	·489	27·71	·42	28·13
	27	15	10	18·0	13·0	−·444	−24·90	−·41	−25·31

The first four columns of the above table sufficiently explain themselves. The fifth gives the distance from the centre of the disc, where the semi-axis minor = 1; and the sixth the corresponding latitude according to Dr. Lohse's useful little table, published in "Publicationen des Astrophysikalischen Observatoriums zu Potsdam," No. 9, p. 7. Column 7 contains the corrections to be added to the preceding latitudes, arising from the elevation of the Earth above the plane of *Jupiter's* equator. They are taken from Mr. Marth's invaluable "Ephemeris for Physical Observations of *Jupiter*" in the *Monthly Notices*. Finally, in the last column are the true zenographical latitudes. The mean position of the middle of the belt No. 6, from the measurements of eight plates, is −27°·54, with a probable error of ±0°·32. The observation of September 14 is rejected for obvious reasons.

The measures relating to the other belts have been reduced in an exactly similar manner to the above. With one exception, where it is doubtful what was the exact part of the belt measured, all the measures have been made use of, though in some cases, by rejecting one or two of them, the separate results might be made a good deal more accordant and the probable errors of the final determinations smaller, the latitudes of some of the belts evidently varying a little in different parts of the planet. Belt No. 6 may be instanced as an example of this. The last measure (October 27) relates to the part just preceding the red spot, and the belt here was at that time clearly more northerly than at other parts.* A measure of the first plate of October 19, giving a latitude of −17°·68, has not been made use of, the middle of

---

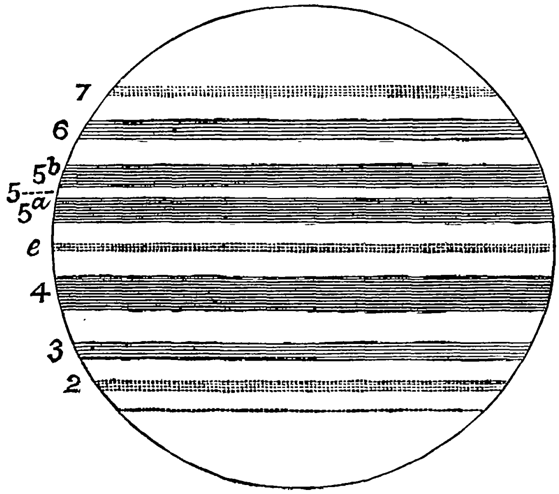
* This belt was also considerably broader at some parts of the planet than at others, which circumstance must doubtless have affected the measures.

1891MNRAS..51..402W

the bright zone south of the dark south equatorial belt having evidently been inadvertently measured, instead of the middle of the latter belt. The final resulting positions of the middle points of the principal belts are given in the following table :—

Belt.	Mean Latitude.	Dist. from Centre.	No. of Plates.
7	−38°·45	−·647	1
6	−27·54 ± 0·32	−·486	8
5*b*	−15·45 ± 0·07	−·283	3
5	−11·80 ± 0·19	−·218	11
5*a*	− 8·23 ± 0·24	−·153	5
e	+ 0·21 ± 0·10	+ ·004	18
4	+ 10·37 ± 0·17	+ ·192	18
3	+ 24·55 ± 0·12	+ ·438	18
2	+ 33·35 ± 0·55	+ ·575	3
	Red Spot.		
S. edge...	−28°·00	−·494	1
Centre (apparent) ...	−20·53	−·371	1
N. edge	−13·51	−·249	1

The distances from the centre are those corresponding to the latitudes given in the second column, or when the elevation of the Earth above the plane of *Jupiter's* equator is nil. Belt No. 5 is the south equatorial belt. It is actually double, being composed of two parallel dark bands, separated by a narrow bright rift, and this duplex character is shown very clearly on several of the Lick photographs. 5*a* refers to the northern and 5*b* to the southern component of this double belt. By means of the distances from the centre given above, the positions of the belts have been laid down in the diagram.



1891MNRAS..51..402W

On one plate, dated September 21, the outside dimensions of the red spot were measured by Professor Holden as follows: Length, $6{\cdot}6^{\mathrm{mm}}$; breadth, $2{\cdot}4^{\mathrm{mm}}$; distance from E. end to limb, $6{\cdot}0^{\mathrm{mm}}$; distance from W. end to limb, $6{\cdot}3^{\mathrm{mm}}$. According to these measures the photograph was obtained $1{\cdot}6^{\mathrm{m}}$ before the centre of the red spot had arrived on the central meridian of the disc. The photograph was taken at either $16^{\mathrm{h}}\ 8^{\mathrm{m}}$ *or* $16^{\mathrm{h}}\ 10^{\mathrm{m}}$ G.M.T. Assuming the mean of these to be correct, the spot would have transited at $16^{\mathrm{h}}\ 10{\cdot}6^{\mathrm{m}}$ G.M.T.; and the centre consequently preceded the zero meridian of Mr. Marth's ephemeris (System II.) by $8{\cdot}2^{\mathrm{m}}$. Visual observations make the difference somewhat greater. From observations by the writer the spot at that time preceded the zero meridian by about 15^{m}.

Measures of the position of a small dark spot on the north side of the N. equatorial belt were also made on two photographs taken on July 13. These give for the time of the transit of the spot over the central meridian of the disc, $21^{\mathrm{h}}\ 24{\cdot}7^{\mathrm{m}}$ G.M.T. from one plate, and $21^{\mathrm{h}}\ 28{\cdot}1^{\mathrm{m}}$ from the other. The mean of these two determinations, $21^{\mathrm{h}}\ 26{\cdot}4^{\mathrm{m}}$, agrees well with visual observations made about the same time, as will be seen from the following list of transits:—

	G.M.T. of Transit.	Foll. Mr. Marth's Zero Mer. System II. by	
1890.	h m	h m	
June 26	12 35·3	2 52·7	Williams, visual
July 3	13 16·3	2 48·7	„ „
13	21 26·4	2 49·1	Holden, photo.
22	13 48·2	2 43·7	Williams, visual
Aug. 1	12 4·0	2 45·3	„ „
2	17 49·5	2 44·1	Barnard*, visual
4	9 31·7	2 43·9	Williams, visual

As there are many measurable dark and light spots shown on the Lick photographs of *Jupiter* in the possession of the Society, suitable measures of this magnificent collection should form a valuable addition to the results obtained directly at the telescope.

It would be interesting to compare the positions of the belts given in this paper with corresponding results obtained by micrometrical measures at the telescope, particularly with the view of ascertaining the relative degree of accuracy of the two methods. Unfortunately, however, it is seldom possible to make a satisfactory comparison, since, although many series of micrometer measures have been made, the results have rarely been fully reduced. The points measured also are not always the same, some observers having measured the edges of the principal belts, and others the middle points of the bands, whilst in some cases it does not clearly appear what was the part measured.

---

* *Publications of the Astronomical Society of the Pacific*, vol. ii. p. 248.

1891MNRAS..51..402W

Belt No. 3 was measured by Dr. O. Lohse, at Potsdam, on four nights in 1879. These measures I have reduced in the same manner as Belt No. 6, *supra*. The same belt was also measured by me in 1888 on three nights, and in 1890 on one night, so that we have the following results :—

Latitude of Belt No. 3.

1879	+20°·32 ± 0°·19	Lohse (4 nights), micrometric
1888	+25·36 ± 0·38	Williams (3 nights), micrometric
1890	+24·55 ± 0·12	Holden (18 plates), photographic
1890	+24·52	Williams (1 night), micrometric

These measures show that a very considerable displacement must have occurred in the place of this belt. From the measures of the position of the red spot made by him on nine nights in 1879–81, Dr. Lohse found the mean latitude to be −21°·52, with a probable error of ± 0°·25*. The latitude being approximately the same as that of Belt 3, this is fairly comparable with the others, so far as regards the probable accuracy of the result.

It would appear from consideration of the probable errors in the above cases, and also from comparison of the agreement *inter se* between the individual results of Dr. Lohse's measures, and between the separate determinations of Professor Holden, that measures of photographs of *Jupiter*, in their present state of perfection, are equal in point of accuracy to the best micrometrical measures; whilst not the least of the advantages of the former method is the power of being able to make the measures at one's leisure, and to repeat them if necessary, or to supplement them by measures of fresh points, so as to be able strictly to compare the positions of objects with the results obtained in previous years.

---

* *Publicationen des Astrophysikalischen Observatoriums zu Potsdam*, No. 9, p. 18. No correction seems to have been applied for elevation of the Earth above the plane of *Jupiter's* equator, so that the probable error is here probably larger than it would otherwise be. As this correction may exceed 3°, it is very important that it should not be neglected, or otherwise the results of one year may differ by more than 6° from those of another year. 6° of zenographical latitude near the equator is equivalent to more than 2″·2 of arc, when the apparent diameter of the planet is 40″.

1891MNRAS..51..402W

Catalogue of 918 *Orbits of Meteor Streams from the Observations of Mr. W. F. Denning.* By J. Kleiber.

(Abstract.)

The following pages contain a catalogue of orbits of meteor-showers,* corresponding to the 918 radiant points given by Mr. W. F. Denning in the May number of the *Monthly Notices* for 1890.

The 918 radiants or orbits represent in reality a much smaller number of distinct streams, many streams being represented by more than one radiant. But as the identification of radiants is a matter still subject to controversy, I found it better to compute the elements for each radiant separately, giving thus a new criterion for their identification *à posteriori* by comparing the elements of their orbits.

The computation has been effected by means of special tables constructed *ad hoc*, which permitted to find directly all the elements *without neglecting the eccentricity of the Earth's orbit.* I retained in the course of the calculation tenths of a degree, rejecting these only in the final result, where I put $\frac{1}{2}$ for 0·3, 0·4, 0·5, 0·6, 0·7, and 1 for 0·8, 0·9, 1·0, 1·1, 1·2.

I may add, as a first preliminary result of my computation, that it confirms the shifting of the radiant of the *Perseids* during the six weeks of the activity of the shower, as observed by Mr. W. F. Denning. A glance at the orbits corresponding to all the radiants related by Mr. Denning to the *Perseid* shower, will show their identity at once.

In the catalogue the number is that of Mr. Denning's list: l, b denote the longitude and latitude of the radiant respectively, Ω, i, $\pi-\Omega$, and q are the usual parabolic elements of the orbit corresponding to the radiant.

St. Petersburg:
1891 *January* 12.

Sur la Détermination récente de la Longitude Paris–Greenwich. Par MM. Bassot et Defforges.

(*Communicated by H. H. Turner, M.A., B.Sc.*)

Voulez-vous nous permettre d'ajouter quelques considérations à celles qu'a déjà développées devant la société monsieur H.-H. Turner sur les résultats de la mesure de la différence de longitude entre Paris et Greenwich, en 1888?

Il existe en effet entre monsieur Turner et nous-mêmes quelques différences d'appréciation, et comme il nous a très-loyalement priés de rendre notre opinion publique et gracieusement offert de la présenter à la Société Royale Astronomique,

---

* Extracted from a book now in the press, *On the Determination of Orbits of Meteor Showers* (in Russian).